

P a t e n t   c l a i m s

1.

A system for ensuring correct insertion and spatial orientation of a prosthesis cup and / or a prosthesis stem of an artificial hip joint, the system comprising:

- 5        a) a tool (30) for controlling the mutual positioning of the main components in a hip prosthesis;
- b) a measuring device (40) for measuring the distance between two supports (2, 2') connected to the patient's pelvis and leg; and
- c) a detachable positioning tool (1) designed to be connected to a handle part (14) connected to the tool (30) according to item a) or to extensions of the prosthesis components, and to the two supports (5, 5') connected to the patients' pelvis and leg.

2.

- 15      Measuring device for measuring the distance between two supports (5, 5') for use during surgical procedures, where said supports are connected to bones in the patient's body, wherein the measuring device comprises an elongated main body (41); a first arm (43) connected substantially perpendicular to the longitudinal axis of and close to one end of said main body; an adjustable member (42) displaceably connected to said main body (41), a second arm (48) being substantially parallel to said first arm(43), connected to the adjustable body (42); connection members (46, 47) arranged at one of the ends of said first (48) and second arm (43), where said connection members are adapted to interact with receptors (5, 5') at the supports (2, 2').

3.

- 30      The measuring device according to claim 2, wherein said first arm (43) is displaceably connected to the main body (41) in a direction substantially perpendicular to the longitudinal axis of said main body (41).

4.

The measuring device according to claim 2, wherein said second arm (48) is  
displaceably connected to the adjustable member (42) in a direction substantially  
perpendicular to the longitudinal axis of said main body (41).

5.

Measuring device according to any of the claims 2-4, wherein the adjustable member  
comprises means to lock the adjustable member to a wanted position along the main  
body.

6.

Measuring device according to claim 5, wherein the adjustable member is adapted to  
receive and interact with a locking member to lock the adjustable member to the main  
body.

7.

Measuring device according to claim 3, additionally comprising means to lock said first  
arm in a wanted position.

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8.

Measuring device according to claim 4, additionally comprising means to lock said  
second arm in a wanted position.

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9.

Measuring device according to claim 7 or 8, wherein said means is a strap.

10.

The measuring device of any of the preceding claims, wherein substantially parallel  
bores are made in the main body and the adjustable body.

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11.

A positioning tool (1) for ensuring correct insertion of a prosthesis cup and / or a prosthesis stem of an artificial hip joint, the tool comprising:  
a handle part (14) adapted to be releasably connected to a tool (30) for controlling the  
5 mutual position of the main parts (31, 32) of a hip prosthesis; and  
two or more flexible arms (7, 7'), where each arm close to a first end thereof, is adapted  
to be releasably connected to said handle part (14) and close to a second end thereof, is  
connected to a connection member (6, 6') that is adapted to interact with receptors (5,  
5') at the supports, and where the flexible arms (7, 7') comprise means to lock the arms  
10 in a wanted configuration.

12.

The positioning tool according to claim 11, wherein the flexible arms comprises arm  
members (8, 9) that are rotably connected to each other about an axis that are  
15 substantially perpendicular to the arm members.

13.

The positioning tool according to claim 11, wherein the flexible arms comprises arm  
members that are telescopically connected to each other.

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14.

Positioning tool according to any of the claims 11-13, comprising means to lock the  
relative position of the arm members in a desired position.

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15.

A method for ensuring correct positioning of the main parts of an artificial hip joint, i.e.  
a prosthesis stem and a cup, wherein the method comprising the following steps:

- a) placing the patient in a well defined start position;
- b) preparing for fixation of supports to the patient's femur and pelvis, respectively,
- c) fixation of said supports to the patients leg and pelvis;
- d) measuring the mutual spatial position of said supports by means of a measuring  
device while the patient lies in said well defined start position;

- e) making the surgical incisions, dividing the femoral neck, preparing the femur and pelvis for receiving the prosthesis parts;
- f) inserting temporarily said main parts of, or trial components of, the prosthesis together with a tool for ensuring correct mutual position of the main parts of the prosthesis components;
- 5 g) again placing the patient in said well defined start position and controlling the start position of the patient, corrected for any planned change in leg length or offset, by means of said measuring device;
- h) if possible, ensuring that the main parts of the prosthesis, or the trial components, are in correct position relative to each other and to the leg and pelvis, respectively, by inspecting the position;
- 10 i) connecting a position device according to claim 11 to the tool for ensuring correct mutual position of the main parts of the prosthesis or ; connecting a position device according to claim 11 to prosthesis or rasp or an extension thereto;
- 15 j) placing the connection members of the flexible arms in receptors on said supports;
- k) locking the flexible arms in a position where the connection members are placed in said receptors;
- 20 l) removing the tools and prosthesis parts;
- m) inserting the prosthesis cup into the pelvis for force fit or together with cement to fasten the stem using the tool for ensuring mutual position of the parts of the prosthesis and using the flexible arm used in step i)- k) above to connect to the support at the pelvis to control that the prosthesis stem has the same position relative to said support as during step k);
- 25 n) in cemented techniques, waiting until the cement is sufficiently cured to remove the tools;
- o) inserting the prosthesis stem into the femur for force fit or together with cement to fasten the stem using the tool for ensuring mutual position of the parts of the prosthesis and using the flexible arm used in step i)- k) above to connect to the support at the femur to control that the prosthesis stem has the same position relative to said support as during step k);
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- p) in cemented technique, waiting until the cement is sufficiently hardened to remove the tools;
- q) removing the tool for ensuring the correct mutual position and reassembling the prosthesis and finalizing the surgical procedure the conventional way.

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16.

The method according to claim 15, wherein said measuring device is used as a drilling guide during steps b) and c).

10 17.

The method according to claim 15, wherein the surgery is performed by minimally invasive surgery.

18.

15 Method according to claim 15, wherein the position of the adjustable body and/or the adjustable arm is performed after step d) before fixing the position of the adjustable arm and adjustable body, respectively, to adjust for planned change in postoperative leg length and/or offset.

20 19.

Method according to any of the claims 15 – 18, wherein the measuring device is locked in its resulting position after measurement and any adjustments for leg length and/or offset.

25 20.

A method for ensuring correct positioning of the main parts of an artificial hip joint, i.e. an prosthesis stem and a cup, wherein the method comprises the following steps:

- r) placing the patient in a well defined start position;
- s) preparing for fixation of supports to the patient's femur and pelvis, respectively,,
- 30 t) fixation of said supports to the patients leg and pelvis;
- u) measuring the mutual position of said supports by means of a measuring device while the patient lies in said well defined start position;

- v) making the necessary incisions, dividing the femoral neck, preparing the femur and pelvis for receiving the prosthesis parts;
- w) inserting the prosthesis stem into the femur and the cup both without or together with cement to fasten them into the femur and pelvis using the tool for ensuring mutual position of the parts of the prosthesis to ensure correct mutual positioning;
- x) replacing the patient in said well defined start position and controlling the position by means of said measuring device;
- y) in procedures where cement is used for fixation, waiting until the cement is sufficiently hardened to remove the tools;
- z) removing the tool for ensuring the correct mutual position and reassembling the prosthesis and finalizing the surgical procedure the conventional way.

21.

- 15 A method for ensuring correct positioning and spatial orientation of the main parts of an artificial hip joint, i.e. an prosthesis stem, neck and cup, wherein the method comprises the following steps:
  - aa) placing the patient in a well defined start position;
  - bb) preparing for fixation of supports to the patient's femur and pelvis, respectively
  - cc) fixation of said supports to the patients leg and pelvis;
  - dd) making the surgical incisions, dividing the femoral neck, preparing the femur and pelvis for receiving the prosthesis parts;
  - ee) inserting temporarily said main parts of the prosthesis together with a tools for ensuring correct mutual position of the main parts of the prosthesis;
  - ff) if possible ensuring that the main parts of the prosthesis are in correct position relative to each other and to the femur and pelvis, respectively, by inspecting the position;
  - gg) connecting a position device according to claim 11 to the tool for ensuring correct mutual position of the main parts of the prosthesis;
  - hh) placing the connection members of the flexible arms in receptors at said supports;
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- ii) locking the flexible arms in a position where the connection members are placed in said receptors;
- jj) removing the tools and prosthesis parts;
- kk) inserting the prosthesis stem into the femur together with or without cement to fasten the stem using the tool for ensuring mutual position of the parts of the prosthesis and using the flexible arm used in step gg) to ii) above to connect to the support at the femur to control that the prosthesis stem has the same position relative to said support as during step ii);
- ll) in cemented procedures, waiting until the cement is sufficiently cured to remove the tools;
- mm) inserting the prosthesis cup into the pelvis without or together with cement to fasten the stem using the tool for ensuring mutual position of the parts of the prosthesis and using the flexible arm used in step gg) and ii) above to connect to the support at the pelvis to control that the prosthesis stem has the same position relative to said support as during step ii);
- nn) if applicable, waiting until the cement is sufficiently cured to remove the tools;
- oo) removing the tool for ensuring the correct mutual position and reassembling the prosthesis and finalizing the surgical procedure the conventional way.

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## 22.

A method for ensuring correct positioning of the main parts of an artificial hip joint, i.e. a prosthesis stem and a cup, where the stem is a modular stem where the neck of the stem may be adjusted relative to the rest of the stem, wherein the method comprises the following steps:

- pp) placing the patient in a well defined start position;
- qq) preparing for fixation of supports to the patient's femur and pelvis, respectively,
- rr) fixation of said supports to the patients leg and pelvis;
- ss) measuring the mutual spatial position of said supports by means of a measuring device while the patient lies in said well defined start position;
- tt) making the surgical incisions, dividing the femoral neck, preparing the femur and pelvis for receiving the prosthesis parts;

- uu) inserting temporarily said main parts of, or trial components of, the prosthesis together with a tool for ensuring correct mutual position of the main parts of the prosthesis components;
- vv) again placing the patient in said well defined start position and controlling the start position of the patient, corrected for any planned change in leg length or offset, by means of said measuring device;
- ww) if possible, ensuring that the main parts of the prosthesis, or the trial components, are in correct position relative to each other and to the leg and pelvis, respectively, by inspecting the position;
- xx) connecting a position device according to claim 11 to the tool for ensuring correct mutual position of the main parts of the prosthesis or ; connecting a position device according to claim 11 to prosthesis or rasp or an extension thereto;
- yy) placing the connection members of the flexible arms in receptors on said supports;
- zz) locking the flexible arms in a position where the connection members are placed in said receptors;
- aaa) removing the tools and prosthesis parts;
- bbb) inserting the prosthesis cup into the pelvis for force fit or together with cement to fasten the stem using the tool for ensuring mutual position of the parts of the prosthesis and using the flexible arm used in step kk)- mm) above to connect to the support at the pelvis to control that the prosthesis stem has the same position relative to said support as during step kk);
- ccc) in cemented techniques, waiting until the cement is sufficiently cured to remove the tools;
- ddd) inserting the prosthesis stem into the femur for force fit or together with cement to fasten the stem and if applicable allow the cement to harden;
- eee) using the tool for ensuring mutual position of the parts of the prosthesis and using the flexible arm used in step kk)- mm) above to connect to the support at the femur and adjusting the modular neck so that the prosthesis stem has the same position relative to said support as during step mm);

fff) removing the tool for ensuring the correct mutual position and reassembling the prosthesis and finalizing the surgical procedure the conventional way.